Psy 524

Lecture 2

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More Review

Hypothesis Testing and Inferential Statistics

- Making decisions about uncertain events
- The use of samples to represent populations
- Comparing samples to given values or to other samples based on probability distributions set up by the null and alternative hypotheses

Z-test
Where all your misery began!!

- Assumes that the population mean and standard deviation are known (therefore not realistic for application purposes)
- Used as a theoretical exercise to establish tests that follow

Z-test

- Sampling distributions are established; either by rote or by estimation (hypotheses deal with means so distributions of means are what we use)

$$\sigma_y \text{ compared to } \sigma_{\bar{y}}$$

$$\sigma_{\bar{y}} = \frac{\sigma_y}{\sqrt{N}}$$

Z-test

- Decision axes established so we leave little chance for error

Reality

Your Decision	H_0	H_A
"H_0"	$1 - \alpha$	β
"H_A"	α	$1 - \beta$
	1.00	1.00

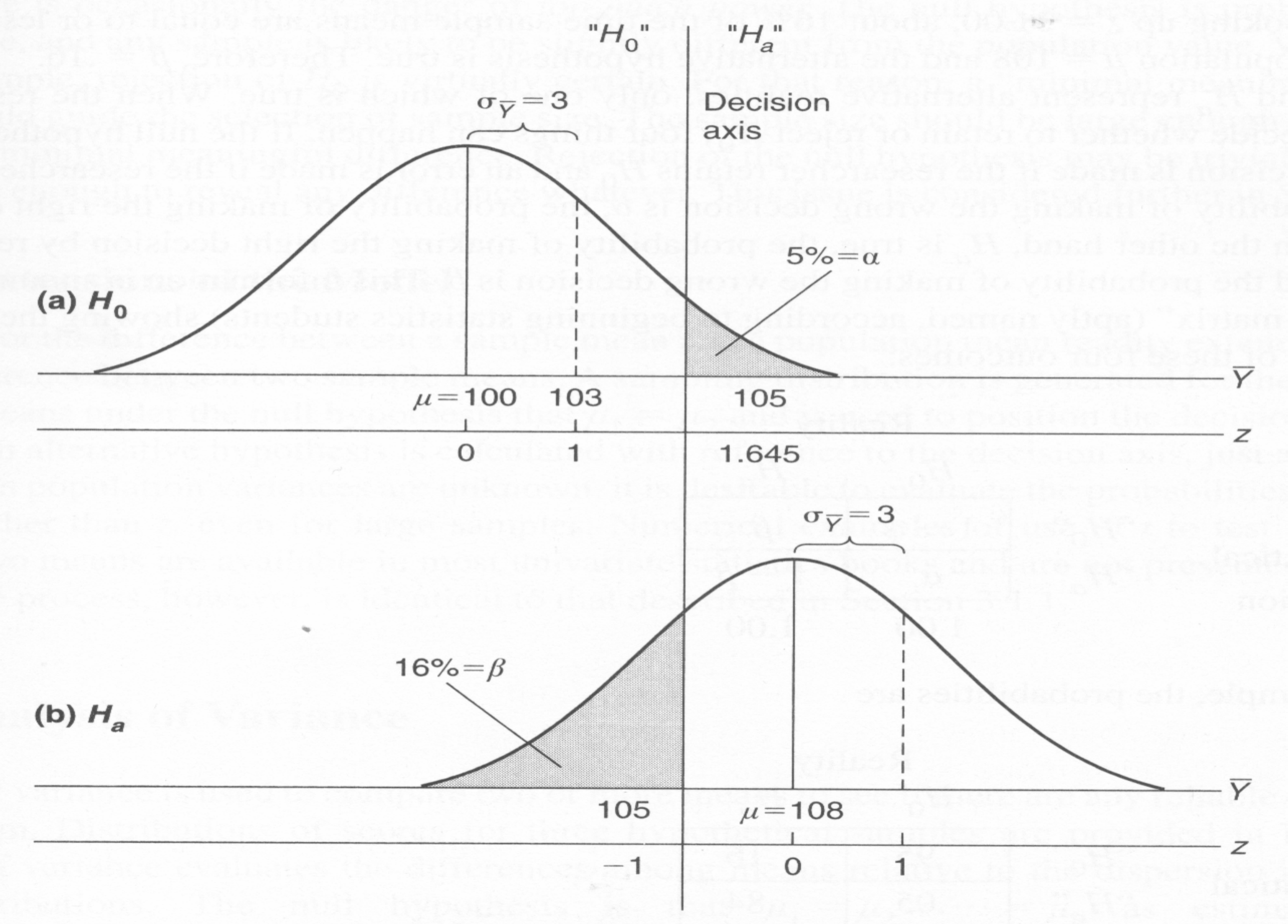
Reality

Your Decision	H_0	H_A
"H_0"	.95	.16
"H_A"	.05	.84
	1.00	1.00

Making a Decision

- Type 1 error – rejecting null hypothesis by mistake (Alpha)
- Type 2 error – keeping the null hypothesis by mistake (Beta)

Hypothesis Testing



Power

- Power is established by the probability of rejecting the null given that the alternative is true.
- Three ways to increase it
  - Increase the effect size
  - Use less stringent alpha level
  - Reduce your variability in scores (narrow the width of the distributions)
    - more control or more subjects

Power

- "You can never have too much power!!" –
  - this is not true
  - too much power (e.g. too many subjects) hypothesis testing becomes meaningless (really should look at effects size only)

t-tests

- realistic application of z-tests because the population standard deviation is not known (need multiple distributions instead of just one)

"Why is it called analysis of variance anyway?"

$$SS_{Total} = SS_{wg} + SS_{bg}$$

$$SS_{Total} = SS_{S/A} + SS_{A}$$

Factorial between-subjects ANOVAs

- really just one-way ANOVAs for each effect and an additional test for the interaction.

- What's an interaction?

DV	$IV1$	$IV2$
$dv1$	$g1$	$g1$
$\vdots$	$g1$	$g2$
$\vdots$	$g2$	$g1$
dvN	$g2$	$g2$

Repeated Measures

- Error broken into error due (S) and (S * T)
- carryover effects, subject effects, subject fatigue etc…

$$\begin{array}{c|c|c|c} Subject & Trial1 & Trial2 & Trial3 \\ s1 & r11 & r12 & r13 \\ \vdots & \vdots & \vdots & \vdots \\ sn & rn1 & rn2 & rn3 \end{array}$$

Mixed designs

$Group$	$Subject$	$Trial1$	$Trial2$	$Trial3$
1	$s1$	$r11$	$r12$	$r13$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
1	$sn1$	$\vdots$	$\vdots$	$\vdots$
2	$sn1+1$	$\vdots$	$\vdots$	$\vdots$
$\vdots$	$\vdots$	$\vdots$	$\vdots$	$\vdots$
3	$sn1+n2$	$\vdots$	$\vdots$	$\vdots$

Specific Comparisons

- Use specific a priori comparisons in place of doing any type of ANOVA
- Any number of planned comparisons can be done but if the number of comparisons surpasses the number of DFs than a correction is preferable (e.g. Bonferoni)
- Comparisons are done by assigning each group a weight given that the weights sum to zero

$$\sum_{i=1}^{k} w_i = 0$$

Orthogonality revisited

- If the weights are also orthogonal than the comparisons also have desirable properties in that it covers all of the shared variance
- Orthogonal contrast must sum to zero and the sum of the cross products must also be orthogonal
- If you use polynomial contrasts they are by definition orthogonal, but may not be interesting substantively

$Constrast1$	$Constrast2$	$1*2$
2	0	0
-1	1	-1
-1	-1	1
0	0	0

Comparisons

$$F = \frac{n_c\left(\sum w_j \bar{Y}_j\right)^2 / \sum w_j^2}{MS_{error}}$$

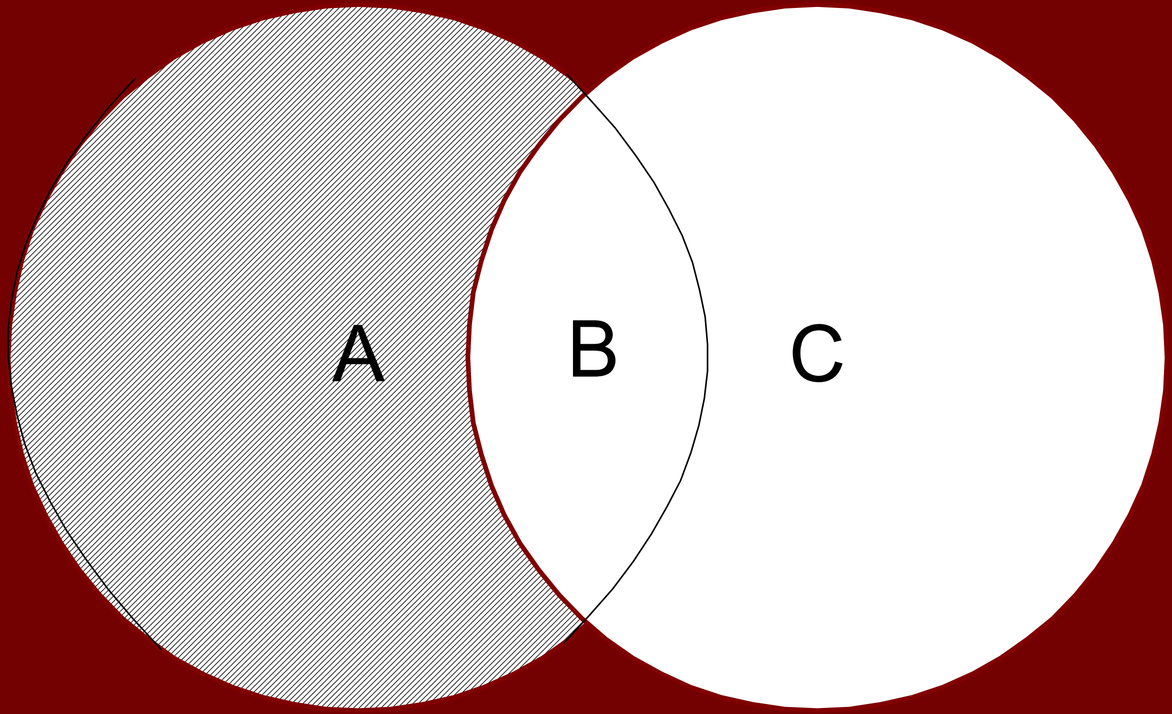
- where n_c is the number of scores used to get the mean for the group and MSerror comes from the omnibus ANOVA
- These tests are compared to critical F's with 1 degree of freedom
- If post hoc than an adjustment needs to be made in the critical F (critical F is inflated in order to compensate for lack of hypothesis; e.g. Scheffé adjustment is (k-1)Fcritical)

Measuring strength of association

- It’s not the size of your effect that matters!!! (yes it is)

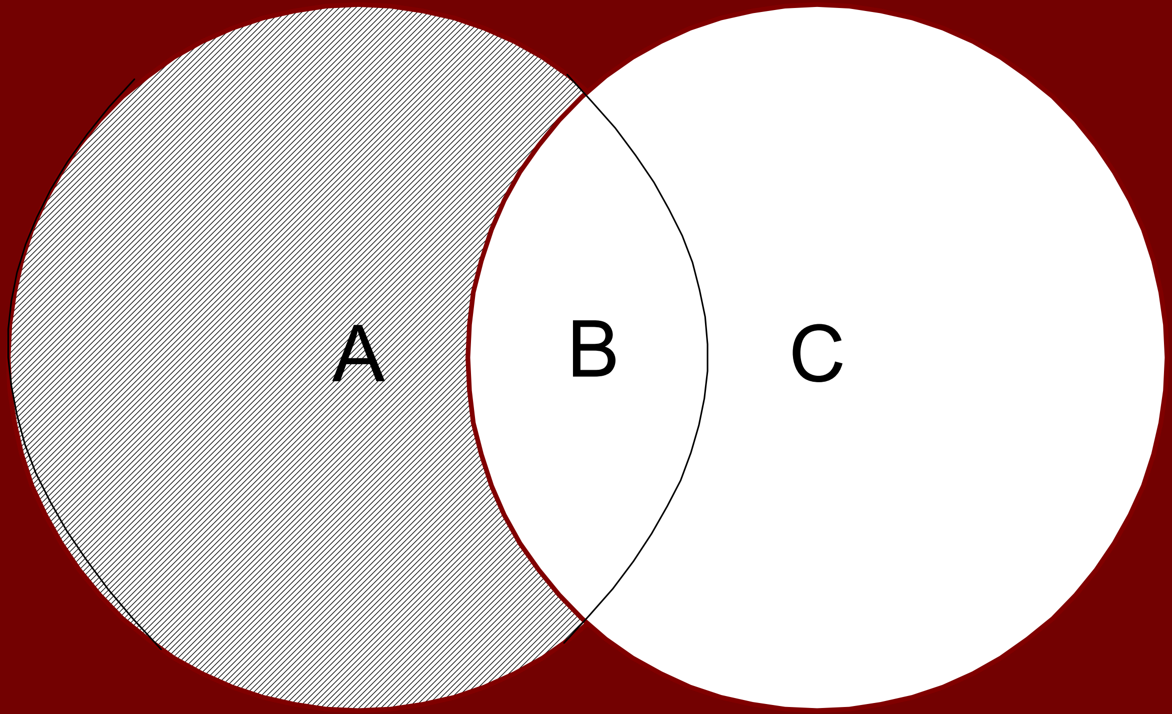
Eta Square (η2)

- ratio of between subjects variation to total variance, it is the same as squared correlation



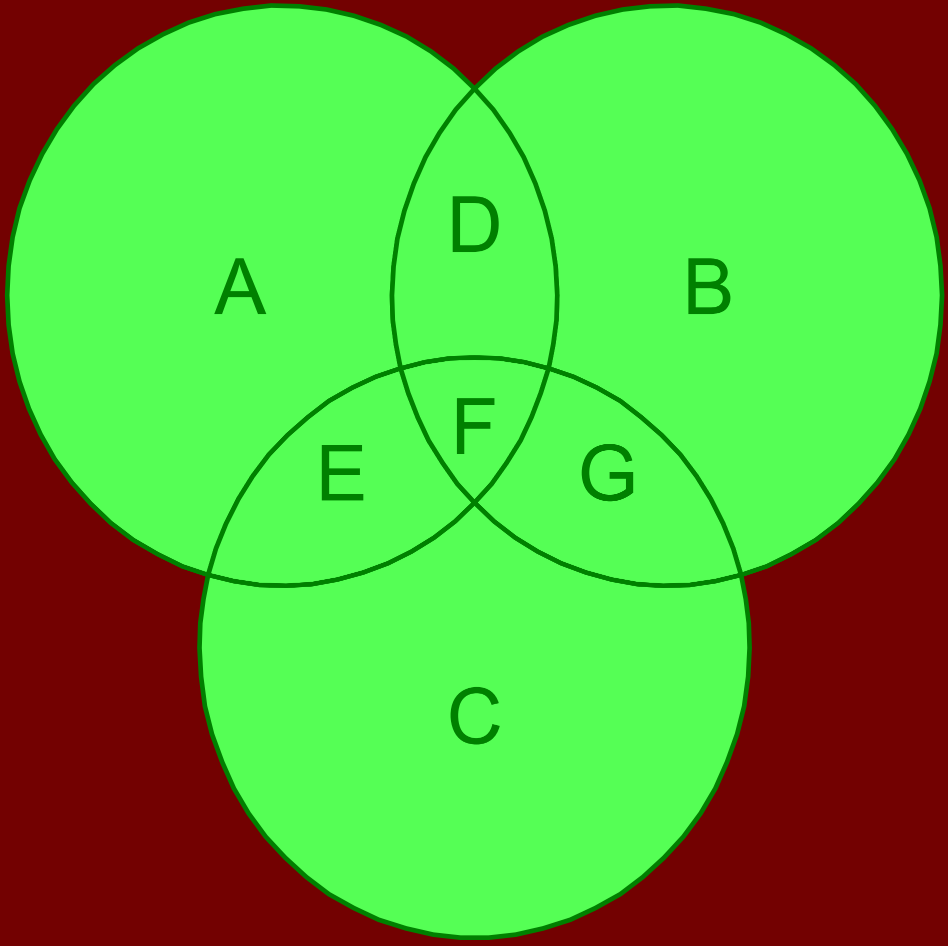
Eta Square (η2)

- For one way analysis = A/A+B



Eta Square (η2)

- For factorial D + F/ A + D + E + F

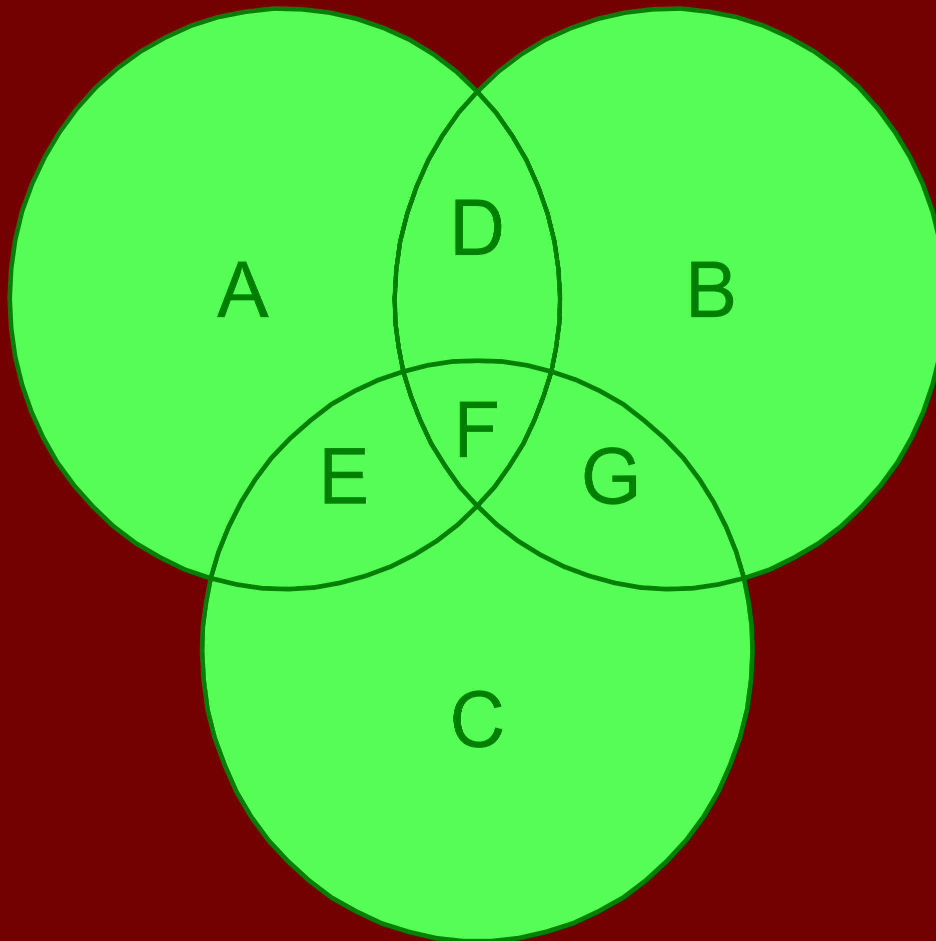


Partial Eta Square

- Ratio of between subjects variance to between variance plus error
- For one way analysis eta squared and partial are the same

Partial Eta Square

- For factorial designs D + F /D + F + A
  - Because A is the unexplained variance in the DV or error



Bivariate Statistics

- Correlation

$$r = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right]\left[N\sum Y^2 - \left(\sum Y\right)^2\right]}}$$

- Regression

$$B = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{\left[N\sum X^2 - \left(\sum X\right)^2\right]}}$$

Chi Square

$$\sum (f_o - f_e)^2 / f_e$$

$$f_e = (row_{sum})(column_{sum}) / N$$